

Evo Edu Outreach (2009) 2:622–628
DOI 10.1007/s12052-009-0172-x

CURRICULUM ARTICLE

Why We Need to Teach the Evolution of Morality

Douglas Allchin

Published online: 2 October 2009
© Springer Science + Business Media, LLC 2009

Abstract I present the case that the topic of the evolution of human morality is essential to any complete introductory biology course. This statement of rationale is accompanied (in complementary contributions) by: (1) a textbook-styled survey of recent literature on the topic, suitable for classroom use or as background for any teacher (Allchin 2009c); (2) a survey of current textbooks and available resources, with a brief discussion of teaching strategies (Allchin 2009d); and (3) a set of online resources (images and presentations) for classroom instruction (Allchin 2009a).

Keywords Evolution · Morality · Charles Darwin · Social Darwinism · Biological determinism

Any animal whatever, endowed with well-marked social instincts, would inevitably acquire a moral sense or conscience, as soon as its intellectual powers had become as well developed . . . as in man.

—Charles Darwin, *Descent of Man*

Ironically, evolutionists and their creationist critics often seem to agree on one thing: that evolution implies moral relativism (Brem et al. 2003). What a dismal prospect for human society, if true! But if Darwin's claim in *Descent of Man* (above) is even vaguely correct, such dire conclusions seem unwarranted. Indeed, substantial scientific research in the past several decades now greatly informs our understanding of the natural history of morality, perhaps the

quintessential question of human evolution. While science cannot dictate specific values or moral principles, it can, nonetheless, explain several dimensions of morality as a form of behavior. A naturalized context can inform moral discourse and choice. Not least, perhaps, such knowledge is critical to rescuing Darwinism (as science) from the awful shadow of the political ideology often called, inappropriately, "Social Darwinism."

Here, I address the role of this topic in a general biology curriculum, presenting the case that no introductory course can now be considered complete without touching upon a handful of central concepts and some illustrative cases of the evolution of morality. A suite of concerns motivates the topic:

1. intellectually, the need to address perhaps the most significant cultural dimension of evolution, itself the most central biological concept;
2. culturally, the need to demythologize biological determinism (presumed to structure human society) and to clarify the relationship of facts and values; and, finally,
3. politically, the need for a key (if only partial) antidote to the onslaught of creationist criticism.

In a complementary contribution, I provide a simple framework for teaching this central topic, addressing the need of many science teachers to learn our relatively newfound knowledge, which also has yet to be fully consolidated at an introductory level (Allchin 2009c). While some examples from research in the past several decades now appear occasionally in introductory textbooks—notably, to illustrate kin selection or inclusive fitness (Allchin 2009b, d)—there is yet no general framework for addressing them as an ensemble, nor for integrating them with the rich heritage of philosophers of ethics. In this parallel essay, I survey the content that needs to be taught, especially for the teacher with no specialized background. This conceptual overview is

D. Allchin (✉)
Program in History of Science and Technology,
University of Minnesota,
148 Tate Physics,
Minneapolis, MN 55455, USA
e-mail: allch001@umn.edu

supplemented with online resources (images, videos, and links) and a discussion of teaching strategies (Allchin 2009a) that may help instructors meet the challenges profiled here. Elsewhere, I assess the current status of textbooks on this topic and profile available books and resources on the scientific content (Allchin 2009d).

A Central Topic in Evolution—and Biology

Why teach biology? Why teach evolution? Primary among the reasons are that they inform human existence and deepen a personal understanding of oneself. Darwin's theory of evolution (or descent with modification, as he phrased it) was revolutionary. But even in Darwin's time, no one regarded it as just a theory of "the origin of species" (divergent speciation), or a handy new way to organize facts about biogeography, taxonomy, embryology, and morphology (from apparently "perfect structures" to vestigial organs)—even though it explained all these things. The major issue—conspicuously understated in the closing of Darwin's 1859 publication—was the implication for the organic identity of humans (Ellegård 1958/1990). At one level, richly caricatured and lampooned, we are cousins to apes. But deeper awareness arose by considering humans' apparently distinctive mental traits and behaviors. Darwin himself lost no time in acknowledging and musing on them. Within months of documenting his first thoughts about branching lineages, in late spring of 1838, he had begun a new private notebook, cryptically labeled 'M': for man? metaphysics? mind? morality?—all are recorded in his reflections. Within three months he had filled all 156 pages—still *before* he had arrived at his insight on natural selection. One entry is especially vivid and telling:

May not moral sense arise from our enlarged capacity acting, yet being obscurely guided or strong instinctive sexual, parental & social instincts, giving rise "do unto others as yourself". "love they neighbor as thyself". Analyze this out.— bearing in mind many new relations from language.— the social instinct more than mere love,— fear for others acting in unison.— active assistance &c &c. [*M Notebook* 150–51]

Darwin was as aware as anybody of the import of his thinking for morality as a human feature (Allchin 2007a). There, penned already in 1838, was an outline of an explanation for the origin of the "moral sense" as a feeling. He would present that very same theory, publicly and more fully developed, three decades later in Chapter 3 of *The Descent of Man*. In opening that chapter, he boldly asserted:

I fully subscribe to the judgment of those writers who maintain that of all the differences between man and

the lower animals, the moral sense or conscience is by far the most important. . . . It is the most noble of all the attributes of man, leading him without a moment's hesitation to risk his life for that of a fellow-creature; or after due deliberation, impelled simply by the deep feeling of right or duty, to sacrifice it in some great cause. (Darwin, 1871, p. 70).

Strictly within a biological context, the natural origin of morality is central to teaching the basics of evolution as a whole.

The Challenges of Biological Determinism and the Fact/Value Distinction

Morality as a topic is all the more important given popular interpretations of Darwin's concept of adaptation through natural selection. Natural selection functions through differential survival and reproduction, preserving only some individuals' traits for the next generation. The process may appear competitive and selfish. It seems to preclude any prospect for cooperation, whether intentional or not. For example, in an imagined community of sharers (where sharing is deemed heritable), cheaters can take advantage of the situation, proliferate at the expense of others, and soon replace the sharers. According to natural selection—narrowly construed—cooperation seems self-defeating. The principles of evolution *seem* to imply that selfishness is *inherent* in nature—hence, "natural," or perhaps essential to "human nature." Such impressions are easily adopted, even by staunch Darwinians (Brem et al. 2003). Both Thomas Henry Huxley, "Darwin's bulldog" in the nineteenth century, and Michael Ruse, the most strident defender of evolution in the late twentieth century, each assumed that non-human nature is inescapably brutish and so appealed to their conspecifics to affirm their "humanity" by rising above it (Huxley 1894/1989; Ruse 1986). Their biological assumption was ultimately unjustified. Mutualisms between species abound—most notably in pollination and seed dispersal and in the endosymbiosis of mitochondria and chloroplasts. Cooperation can be adaptive. It can foster mutual survival. The same can apply within species. The contexts whereby natural selection can promote mutual benefit, while still being "selfish," are not difficult to understand. But the pervasive rhetoric in our society supporting the ideologies of individualism and of economic and academic competition tends to subvert any deeper understanding of selection. To be a "Survivor[®]" (according to CBS's top-10-rated television show) we must "Outwit. Outplay. Outlast.[®]" In our culture, no one needs a biology class to learn how natural selection works. But they likely do need instruction to *unlearn* its oversimplifications and

the misleading impression that moral behavior could never evolve.

The problem posed by misinterpreting selfishness as "natural" is compounded by a widespread, yet also unjustified, tendency to transfer such biology to human interactions. Popular conceptions exhibit the fallacy of biological determinism, or viewing behavior and social interactions reductionistically, as simple extensions of genetics and organismal biology (Lewontin 1992; Rose 1997). In this perspective, commonly construed as the epitome of science, selfish Nature (at the biological level) seems to inevitably dictate a selfish culture (at the social level). Science can thereby easily be perceived (mistakenly) as validating moral relativism and political anarchy (Toumey 1997, pp. 112–27). However, cognitive and social structures shape interactions on higher levels of organization, modifying how individual "lower-level" components function (Murphy and Brown 2007). Minds and societies each exhibit "emergent properties" that are consistent with, but not necessarily easily predicted by, lower-level causes (Holland 1998; Camazine et al. 2001). Exposing the assumptions of biological determinism is one challenge in addressing widespread and deep misconceptions about how selection as a process relates to morality as a product.

A second common misconception is the failure to understand or apply the fact/value distinction (often called "the naturalistic fallacy" in ethics). Evolution can interpret and explain moral behavior. It does not thereby justify any moral values. Facts about nature, even universal facts or apparent findings about "human nature," do not constitute intrinsic values. The term "natural selection" itself can surely be misleading. Darwin's terminology reflects his deliberate modeling of natural selection on artificial selection, based on the analogy of human choice. But nature does not exhibit intent in its "choices" of differential survival, any more than a falling body exhibits a "value" of gravity. Evolutionary science must remain silent with respect to particular moral values, even if it can explain behaviors identified as moral or why certain organisms seem to value some behaviors more than others.

Biological determinism and the conflation of facts and values are each major errors. Combined together, however, these two flaws form a potent nemesis to the public understanding of evolution: what is typically called "social Darwinism." Even the label is mistaken and misleading. The view was most prominently developed by Herbert Spencer, a self-styled philosopher who applied evolution to interpreting the emerging disciplines of psychology and sociology. He popularized an extreme biologizing of society, while linking it to an ideology of "progress" (Hofstadter 1955, pp. 31–50; Richards 1987, 243–94; Farber 1994, pp. 38–57). In the late 1800s, Spencer's works were read far more widely than Darwin. Indeed, it

was Spencer—not Darwin—who coined the phrase "survival of the fittest" (Spencer 1864a/1924, p. 444; Darwin 1868, p. 21; 1869, p. 101). The catchwords reflected Spencer's laissez faire political ideology and helped persuade others that his social doctrine expressed a natural law (Spencer 1851/1969, 1852a, 1852b, 1864a). The doctrine that human society follows—or (ideologically) benefits from—unfettered competition in nature, is thus more aptly called Spencerism (or possibly, based on even earlier precedents, Malthusianism or Hobbism; Allchin 2007b). Historian Richard Hofstadter (1955) originally coined the phrase "social Darwinism" to describe a handful of late nineteenth and early twentieth century American industrialists who strongly endorsed Spencer's principles. Most had never read Darwin. Yet, based on Spencer's writing, they nonetheless appealed to Darwin's fame and used unsubstantiated analogies in trying to rationalize unregulated business and thereby legitimate their privileged status in society. Hofstadter could hardly have guessed in 1944 how his historical label would ultimately adopt a life of its own. The name helps link the long-since-discredited ideas to the accepted science of Darwinism. Students need to learn that Spencerism is a social ideology, not supported by biology. In teaching the science fully and responsibly, we must disentangle Darwinism proper from the perniciously named "social Darwinism."

The second main reason for teaching about the biology of morality, then, largely amplifies the first. In the absence of instruction, profound misconceptions develop about the evolutionary context of ethics and pollute the science. Worse, perhaps, ideology becomes naturalized, or inscribed in an inherently immutable and inviolable "nature," under the guise of scientific principles (Allchin 2008). Responsible biology teachers will thus address the misconceptions and profile how the reasoning is mistaken.

Addressing Critics of Evolution

There is yet a third important reason for teaching about the natural history of ethics: prevalent politically empowered (but religiously cloaked) criticism of evolution. For many, the ghastly specter of Spencerism, construed as an inevitable consequence of evolutionary principles, is unacceptable on religious grounds (Ellegård 1958/1990, 321–29, and below). Evolution seems to threaten the moral precepts and guidance integral to their religious convictions. They fear the absence of a moral compass. For them, Darwinism is ultimately "secular humanism," a doctrine that will, unchecked, supplant religion with a dangerous moral void (Toumey 1997). Striving to defend morality and its religious foundations, these persons dismiss the problematic science. The desire for moral security as a

motivation for much anti-evolutionism has, in my view, been greatly underappreciated.

Such criticism is not surprising in a historical perspective. Darwin's theory of descent with modification was both celebrated and condemned when presented in 1859 (Hull 1973). Most popular criticism surrounded the nature of humans (Ellegård 1958/1990). Some was emotional: the perceived indignity of "brutish" apes as cousins. Some was religious: the threats of materialism for the nature of a soul and a purposeful life. Yet the core concern over Darwinism was ultimately ethical: did evolution not obliterate the prospect of morality and a civil society here and now? (Shurman 1887).

Darwin, of course, addressed the question in 1871 in *Descent of Man*, where he sketched a theory of how human intellectual faculties and, most importantly, the moral sense might evolve (epigraph above). He presented an explanation for the origin of good will and conscience, based on four features. First, social animals would develop a *social instinct* for helping conspecifics. Second, *memory* would foster reflection on violations of that instinct for other short-term instincts. Third, *language* would enhance the communication of emotional states and needs, to facilitate sympathetic responses. Fourth, *habit* would develop (through learning), yielding immediate responses and spontaneous feelings of duty.

The *Edinburgh Review* did not respond favorably:

The sense of right and wrong, according to this view is no definite quality, but merely the result of the working together of a series of accidents controlled by natural selection for the general good. We need hardly point out that if this doctrine were to become popular, the constitution of society would be destroyed, for if there be no objective right and wrong, why should we follow one instinct more than the other, excepting so far as it is of direct use to ourselves?

London's *Guardian* echoed the same sentiments, underscoring the significance of the issue:

The moral sense or conscience [is] most important to the true humanity of the individual and to the maintenance of society. If any theory tends to depose it from its spiritual throne . . . and makes it but an instinct differing from others only in the greater vividness and durability . . . such a theory comes home to those who care little about abstract metaphysics, and is pregnant with results which pass beyond the school lecture room, to affect the great issues of practical life. (Ellegård 1958/1990, pp. 323–24).

Beyond the school lecture room, indeed. That may signal modern educators concerned about "scientific literacy." For many in Darwin's day, human evolution meant abandoning

morality, leaving only social anarchy. *Saturday Review* summarized it bluntly in 1859:

No conceivable amount of evidence derived from the growth and structure of animals and plants would have the slightest bearing upon our convictions in regard to the origin of conscience (Ellegård 1958/1990, p. 325).

The fundamental challenge was—and perhaps still is—articulating how moral behavior can arise through natural selection, with its image of dog-eat-dog competition and selfishness (Larson 2006).

Anti-evolutionists today echo their precedents (Toumey 1997; Paul Nelson, Discovery Institute Fellow, personal communication, Feb. 16, 2009). The pro-creationist Discovery Institute issued a policy document asserting:

Ever since Darwin's day, people have been concerned that his theory undercuts morality in the traditional sense—and they are right (Pearcey 2000).

Critics fault Darwinism (and Darwinism alone) for eugenics, "ruthless capitalism," hedonism and anarchy (Bergman 2001a, 2001b; Wiker & Demski 2002; West 2007). They rail against the imagined subversion of moral authority and order:

. . . We are witnessing the "leading edge" of evolutionary research drawing towards the inevitable and logical conclusion that in a world without a God there is no objective basis for moral truth. There is only human preference. A frightening, anarchical proposition. . . .

There can be no such universal principles as 'right' or 'wrong' in an evolutionary system as there is no higher authority for such principles than man himself—who is no more valuable than his own opinion would deem him to be (Ramsey 2004)

Like their historical antecedents, modern critics trivialize evolutionary explanations or fail to understand them:

The evolutionary explanation disembowels morality, reducing it to mere descriptions of conduct. . . .

When morality is reduced to patterns of behavior chosen by natural selection for its survival value, then morality is not explained; it's denied. . . .

What Darwinists cannot do is give us a reason why we ought not simply copy nature and destroy those who are weak, unpleasant, costly, or just plain boring. . . .

In the end, we must accept one of two alternatives. Either we live in a universe in which morality is a meaningless concept and thus we are forever con-

demned to silence regarding any moral issue, or moral rules exist and we're beholden to a moral God who holds us accountable to his law. There are no other choices (Koukl 1998).

History may alert modern biology educators to the challenges in teaching evolution that have persisted ever since Darwin. Evolution education is not just about interpreting patterns in fossils, mastering principles of natural selection, or appreciating some unifying theme in biology. Nor is it just about profiling the "nature of science" more effectively. It is also critically about conveying an understanding of who we are as moral beings in the context of our organic history.

Rejecting evolution and science based on perceived ethical implications is ill informed, of course. (Not least is the failure to distinguish evidential and values-based reasoning.) Yet current educational practice may bear some responsibility. Basic knowledge about the relation of evolution and morality is not part of standard science curricula. How can anyone then justly feign despair when such impressions become widely believed? Science cannot answer purely religious questions, nor dictate personal beliefs. But for those truly concerned with the status of morality in the context of evolution, contemporary science can certainly prove informative. In particular, it may be important to show explicitly how science does not force a harsh either-or choice between a moral society or evolutionary biology. Moral behavior can be a product of human evolution. Where, alternatively, anti-evolutionism is more political than religious (Forrest and Gross 2004), the same facts about the biology of morality may provide important counterarguments to deflect or weaken anti-evolution rhetoric. Teaching the biology of morality may well be useful politically, as well as in personal and cultural contexts.

Prospects

Many strong reasons thus support teaching the evolution of morality. Until relatively recently, however, one might well have considered the prospect bleak, simply for want of enough relevant science. Of course, reflections on biology and ethics have hardly been scarce since 1859 (Farber 1994)—or even before! (Maienschein and Ruse 1999). Darwin presented his own theory of how moral sense could evolve in 1871, while his oft-time defender Thomas Huxley offered a contrary view, of humans cast in a world of inherent competition. Herbert Spencer promoted evolution as an engine of progress and thus a "natural" value, prompting philosopher G.E. Moore in harsh criticism to articulate the naturalistic fallacy in 1903. Many great evolutionary biologists in the century following Darwin—

Julian Huxley, C.H. Waddington, Theodius Dobzhansky, G. G. Simpson, among others—weighed in on the subject of ethics. In the 1960s, focus shifted to the individual: George C. Williams (1966) issued a potent critique of "the good of the species" and William Hamilton (1974) formalized the notion of inclusive fitness and kin selection. They reflected in part the outlook of the Cold War era (expressed, too, in Ardrey's *The Territorial Imperative*; just as Petr Kropotkin's 1902 *Mutual Aid* and 1924 *Ethics: Origin and Development* had been shaped by Tsarist oppression and Communism in Russia). Still, they introduced important benchmarks for thinking critically about natural selection and social behavior. (A more tempered alternative, reciprocal altruism, introduced by Robert Trivers in 1971, was mostly overshadowed for the next two decades.) In 1975, E.O. Wilson largely echoed the prevalent genocentric bias in his *Sociobiology*, but now tied to substantive field studies (especially on insects). Wilson's provocative (though brief) comments on humans sparked considerable debate. Richard Dawkins took Wilson's stance to an extreme in his popular 1976 *The Selfish Gene*, while others profiled the poverty of genetic determinism and its political contexts (Lewontin et al. 1984). Wilson's book also motivated a Dahlem Conference that brought together experts from primatology, psychology, child moral development, cultural and social anthropology, neurobiology, legal philosophy, and other fields (Stent 1978), a model for further interdisciplinary discourse. Ultimately, questions about sociobiology helped motivate a generation of fruitful new research. More research yielded more understanding. For example, Florida scrub jays appeared to exhibit kin selection by helping to raise siblings even when reproductively mature. Woolfenden and Fitzpatrick (1978) soon discovered a more complex (and more interesting) scenario of social costs and benefits. Such studies over the past three decades—of chimps and bonobos, macaques and meerkats, bees, wasps and ants, Belding ground squirrels and sticklebacks, vampire bats and naked mole rats, and more—have greatly enhanced our knowledge of the biology and evolutionary contexts of ethics. Research has emerged in complementary fields: neurobiology, cognitive development, social psychology, cultural anthropology, economics, etc. The science is now fairly robust (although far from complete!). In addition, there are ample cases to illustrate a handful of significant core concepts in the classroom.

Understanding has been further enriched since the late 1980s by contributions from the history and philosophy of biology. In 1981, philosopher Michael Ruse testified on the nature of science at the Arkansas trial on teaching creationism. He continued to debate creationism publicly and on one occasion (in a television make-up room) creationist Duane Gish asked him how any self-respecting evolutionist could believe in a moral society. As a response,

Ruse wrote *Taking Darwin Seriously* (1986), a philosophical reappraisal of Darwin's, Huxley's, and others' views. Shortly thereafter (in 1990), the Field Museum in Chicago devoted its renowned annual spring systematics symposium to evolution and ethics (Nitecki and Nitecki 1993). In 1987, historian Robert Richards published an award-winning volume, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior*. Since these benchmarks, historians and philosophers of science have given increasing focus to ethics as an evolutionary issue. In the last decade, biologists and philosophers have deepened their dialogue. Philosopher Elliot Sober and biologist David Sloan Wilson (1998) collaborated in an insightful analysis of altruism and group selection. Similarly, primatologist Frans de Waal has opened his interpretations of primate behavior to critique by philosophers (de Waal 2006; Katz 2004). The field of the biology of morality is thus also developing and benefitting from greater philosophical sophistication.

On the occasion of the Darwin bicentennial (and the sesquicentennial of the *Origin of Species*), we might find some newfound confidence about the outlines of the evolution of morality, echoing Darwin's concerns—yet also updated with modern research. While current textbooks do typically address this topic, the treatment is generally incomplete and tends to exhibit an outmoded reductionistic bias (fuller, more detailed analysis in Allchin 2009b, d). Updating knowledge on this topic may be challenging and require a little extra homework for teachers. What does someone need to know to understand the evolution and biology of morality effectively? Not that much, really. The basic concepts and examples already available in standard textbooks need to be simply highlighted, extended, and further synthesized. In a complementary paper, therefore, I provide a textbook-insert and an organizational framework of this rapidly growing field (Allchin 2009c). Accompanying classroom resources (including images and video links) and a discussion of teaching strategies are available online (Allchin 2009a). A survey of books is provided in another contribution (Allchin 2009d). With these resources, we may teach more fully what evolution means—not just as a unifying principle of biology, but as a great insight into what it means to be a human with a deep organic history.

References

- Allchin D. Was Darwin a Social Darwinist? *American Biology Teacher*. 2007a;69:49–51.
- Allchin D. Social unDarwinism. *American Biology Teacher*. 2007b;69:113–5.
- Allchin D. Naturalizing as an error-type in biology. In: *Proceedings of the Sixth Brazilian Conference for the History and Philosophy of Biology*. São Paulo: Mackenzie University; 2008.
- Allchin D. The Evolution of Morality [website]. URL: EvolutionOfMorality.net (accessed February 12, 2009); 2009a.
- Allchin D. This great question': teaching the biology of morality. Chicago: American Association for the Advancement of Science Annual Meeting; 2009b.
- Allchin D. The evolution of morality. *Evolution: Education and Outreach*; 2009c. doi:10.1007/s12052-009-0167-7
- Allchin D. Teaching the evolution of morality: status and resources. *Evolution: Education and Outreach*; 2009d. doi:10.1007/s12052-009-0173-9
- Bergman J. Darwin's influence on ruthless laissez faire capitalism. *Impact* (#333). El Cajon, CA: Institute for Creation Research. URL: www.icr.org/article/454/65/ (accessed December 7, 2007); 2001a.
- Bergman J. The effect of Darwinism on morality and Christianity. *Impact* (#336). El Cajon, CA: Institute for Creation Research. URL: www.icr.org/article/449/65/ (accessed December 7, 2007); 2001b.
- Brem SK, Ranney M, Schindel J. Perceived consequences of evolution: college students perceive negative personal and social impact in evolutionary theory. *Sci & Educ*. 2003;87:181–206.
- Camazine S, Deneubourg J-L, Franks NR, Sneyd J, Theraulaz G, Bonabeau E. *Self-organization in biological systems*. Princeton: Princeton University Press; 2001.
- Darwin C. *On the origin of species*. London: John Murray; 1859.
- Darwin C. *The variation of animals and plants under domestication*. London: John Murray; 1868.
- Darwin C. *On the origin of species*. 5th ed. London: John Murray; 1869.
- Darwin C. *The descent of man*. London: John Murray; 1871.
- Ellegård A. *Darwin and the general reader*. Chicago: University of Chicago Press; 1958/1990.
- Farber P. *The temptations of evolutionary ethics*. Berkeley: University of California Press; 1994.
- Forrest B, Gross P. *Creationism's Trojan horse*. Oxford: Oxford University Press; 2004.
- Hamilton W. The genetical theory of social behavior. *J Theor Biol*. 1974;7:1–52.
- Hofstadter R. *Social Darwinism in American thought*. revth ed. Boston: Beacon Books; 1955.
- Holland JH. *Emergence: from Chaos to order*. Cambridge: Perseus; 1998.
- Hull D. *Darwin and his critics*. Chicago: University of Chicago Press; 1973.
- Huxley TH. *Evolution and ethics* [facsimile edition, with essays by James Paradis and Geroge C. Williams]. Princeton: Princeton University Press; 1894/1989.
- Katz L. ed. *Evolutionary origins of morality*. Exeter, UK, 2004.
- Koukl G. Monkey morality: Can evolution explain ethics? *Christian Research Journal* 20(4). Also issued as Statement DC732, Christian Research Institute. URL: www.equip.org/site/c.mu11LaMNJrE/b.2715355/k.B089/DC753.htm (accessed December 11, 2007); 1998.
- Larson BMH. The social resonance of competitive and progressive evolutionary metaphors. *Bioscience*. 2006;56:997–1004.
- Lewontin RC. *Biology as ideology: the doctrine of DNA*. New York: Harper Collins; 1992.
- Lewontin RC, Rose S, Kamin LJ. *Not in our genes*. New York: Pantheon Books; 1984.
- Maienschein J, Ruse M. *Biology and the foundation of ethics*. Cambridge: Cambridge University Press; 1999.
- Murphy N, Brown WS. *Did my neurons make me do it?: Philosophical and neurobiological perspectives on moral responsibility and free will*. Oxford: Oxford University Press; 2007.
- Nitecki M, Nitecki D, editors. *Evolutionary ethics*. Albany: State University of New York Press; 1993.

- Pearcey NR. Why Darwinism Matters (Discovery Institute, Washington DC Policy Briefing). Addison, TX: Christian Leadership Ministries (Leadership U). URL: www.leaderu.com/orgs/arn/pearcey/np_dcpolicy0500.htm (accessed February 17, 2009); 2000.
- Ramsey JM. What basis, morality? Answers (May 11). URL: www.answersingenesis.org/docs2004/0511basis.asp (accessed December 7, 2007); 2004.
- Richards R. Darwin and the emergence of evolutionary theories of mind and behavior. Chicago: University of Chicago Press; 1987.
- Rose S. Lifelines: life beyond the gene. Oxford: Oxford University Press; 1997.
- Ruse M. Taking Darwin seriously. New York: Basil Blackwell; 1986.
- Shurman JG. The Ethical Import of Darwinism, 3d ed. Charles Scribner's Sons; 1887/1903.
- Sober E, Wilson DS. Unto others. Cambridge: Harvard University Press; 1998.
- Spencer H. Social statics. London: John Chapman; 1851/1969. Reprinted by Augustus M. Kelley, New York.
- Spencer H. A theory of population, deduced from the general law of animal fertility. Westminster Review. 1852a;57:468–501.
- Spencer H. The development hypothesis. The Leader (March 20); 1852b.
- Spencer H. First principles. 6th ed. New York: Appleton; 1864a/1924.
- Spencer H. Principles of biology, vol. 1. London: Williams & Norgate; 1864b.
- Stent GS, editor. Morality as a biological phenomenon. Berkeley: University of California Press; 1978.
- Toumey C. Conjuring science. New Brunswick: Rutgers University Press; 1997.
- Trivers RL. The evolution of reciprocal altruism. Q Rev Biol. 1971;46:35–57.
- de Waal F. Primates and philosophers: how morality evolved. Princeton: Princeton University Press; 2006.
- West JG. Darwin day in America: how our politics and culture have been dehumanized in the name of science. Wilmington: Intercollegiate Studies Institute; 2007.
- Wiker B, Demski W. Moral Darwinism: how we become hedonists. Downers Grove: Intervarsity Press; 2002.
- Williams GC. Adaptation and natural selection. Princeton: Princeton University Press; 1966.
- Wolfenden GE, Fitzpatrick JW. The inheritance of territory in group breeding birds. Bioscience. 1978;28:104–8.